DOI: https://doi.org/10.34123/jurnalasks.v16i2.652

Available online at https://jurnal.stis.ac.id/

Jurnal Aplikasi Statistika & Komputasi Statistik
Vol. 16 No. 2, December 2024
e- ISSN: 2615-1367, p-ISSN:2086-4132

Patterns, Determinants, and Elasticity of Household Food Consumption in Indonesia (Period 2021-2022)

Wifa Darma Aulia[1*], Rita Yuliana[2]

[1]*BPS-Statistics Dharmasraya Regency, Indonesia*
[2]*Politeknik Statistika STIS, Jakarta, Indonesia*
**Corresponding Author: E-mail address:* [1]wifa.darma@bps.go.id,[2]rita@stis.ac.id

ARTICLE INFO

Article history:
Received 27 October, 2023
Revised 2 September, 2024
Accepted 2 September, 2024
Published 31 December, 2024

Keywords:
Elasticity; food consumption patterns; LA-AIDS; strategic food commodities; volatile food.

Abstract

Introduction/Main Objectives: The increase in strategic food commodity prices contributed significantly to the inflation rate. In March 2022, the inflation rate for the food, beverage and tobacco category reached 3.59% (y-o-y). This increase in the price of strategic food commodities makes it difficult for households. The continued increase in food prices resulted in a decrease in household purchasing power, thereby reducing the level of household welfare in Indonesia **Background Problems:** Based on these problems, research is needed on the impact of rising prices of strategic food commodities on changes in household food consumption patterns in Indonesia. Therefore, what is the description of household food consumption patterns and the factors that influence them; and what is the elasticity of household food demand in Indonesia in the period March 2021 and March 2022? **Novelty:** The novelty of this research is to calculate the elasticity of food demand in Indonesia for the period March 2021 and March 2022 by fulfilling the assumptions of demand theory so that the value can be trusted, while several studies do not apply the assumptions of demand theory. **Research Methods:** This study used the Linear Approximated-Almost Ideal Demand System (LA-AIDS) model with the Seemingly Unrelated Regression (SUR) method. **Finding/Results:** The research results show that in March 2022 there was an increase in the price of strategic food commodities and a change in household food consumption patterns in Indonesia. The own price elasticity value shows a negative number. The cross price elasticity of some food groups is negative and some is positive. The elasticity of total expenditure shows that all food groups are normal goods.

1. Introduction

The problem of food security is still a challenge for all countries. The unstable world economic condition is one of the causes of this problem. In 2020, conditions of Food security are getting worse due to problems in food distribution. This happened because of the social restrictions implemented in various countries during the Corona virus Disease 2019 (COVID-19) pandemic which brought economic activity to a halt [1]. These social restrictions cause food supply chains that are interconnected with each other to be disrupted, starting from the production, distribution, and consumption of food for the population both globally and domestically. As a result, there was an increase in prices for several food commodities, especially strategic food commodities.

The increase in prices of strategic food commodities makes a large contribution to the inflation rate (volatile foods) [2]. In March 2022, the Consumer Price Index (CPI) for the food, beverage, and tobacco group reached 113.32 with an inflation rate of 3.59 percent compared to March 2021 [3]. In the last five years, of the 15 strategic food commodities that contributed to increasing inflation, there was a dominant food commodity, namely cooking oil [4]. The rural consumer price for cooking oil in March 2021 was IDR 15,095.00/Kg and increased in March 2022 to IDR 19,640.00/Kg [5]. The average increase in consumer prices for cooking oil in 2022 will reach 30.81% compared to the previous year. The high demand and decreasing supply of cooking oil have resulted in a shortage and increase in cooking oil in Indonesia [6], even though cooking oil is a food ingredient that is often used by households for cooking. Apart from cooking oil, average rural consumer prices for several other strategic food commodities have also increased. This can be seen in the following table:

Table 1. Average rural prices for several strategic food commodities in 2021 and 2022 (Rupiah)

Food Commodities	Average rural prices (Rupiah)		% Change
	2021	2022	
Rice	11,348	11,554	1.815
Beef	112,870	117,218	3.852
Purebred chicken meat	37,809	40,008	5.816
Chicken eggs	27,196	29,051	6.821
Cooking oil	15,701	20,538	30.807
Red chili pepper	42,194	51,104	21.117
Red onion	30,641	36,345	18.616
Garlic	30,271	30,713	1.460

Source: BPS (2021 and 2022b)

This increase in the price of strategic food commodities makes it difficult for households, especially for households with lower middle income. The short-term impact of increasing food prices is that it can reduce household purchasing power. When food prices increase, households will respond by reducing demand for that food or replacing it with cheaper food. This statement is in accordance with demand theory [8]. This phenomenon indicates that there is a decline in purchasing power and this will subsequently change household food consumption patterns. The long-term impact of increasing food prices is to reduce the level of household welfare [9]. This can happen because households cannot meet their basic needs.

Changes in consumption patterns will have an impact on changes in food demand. The magnitude of changes in food demand can be seen from the elasticity value of household food demand. The elasticity value of household food demand can be estimated using the Almost Ideal Demand System (AIDS). Estimation of food demand models using the AIDS model has been carried out by several researchers, namely [10], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], and [21]. Some of this research only examines the elasticity of food demand in one province and only focuses on one food commodity group, with the exception of research by [21]. In [21], Yuliana conducted research on food demand and changes in household welfare levels covering all foodstuffs in Indonesia in March 2016.

Based on these problems, research is needed on the impact of rising prices of strategic food commodities on changes in household food consumption patterns in Indonesia. Therefore, the aim of this research is to analyze the description of household food consumption patterns and the factors that influence them; and analyze the elasticity of household food demand in Indonesia in the period March 2021 and March 2022. This is because, in the period March 2021 to March 2022 there were several phenomena that resulted in an increase in food prices as previously explained. It is hoped that this research can be used as a reference for the government to create policies that have an impact on household food consumption patterns so that they can improve household welfare.

2. Material and Methods

2.1. Type of Research

This study uses quantitative research methods. This method is carried out by processing household sample data using statistical analysis and hypothesis testing has been carried out previously.

2.2. Location and Time Research

This research related to Patterns, Determinants, and Elasticity of Household Food Consumption in Indonesia was conducted during the lecture period at STIS Statistics Polytechnic as a requirement for the final thesis assignment. This research was conducted for approximately 9 months.

2.3. Data Collection Sources and Strategies

This research uses primary data from the National Socioeconomic Survey (SUSENAS) sourced from the Central Statistics Agency (BPS). The data collected is SUSENAS data for the period March 2021 and March 2022 in cross-sectional form by sampling household units in Indonesia. SUSENAS data for March 2021 and March 2022 covers 345,000 sample households with a response rate for each period of 99.75 percent or 344,148 households and 99.92 percent or 343,879 households.

All food commodities contained in SUSENAS data are grouped into 12 food groups. This grouping was formed based on the grouping of CPI calculations, policy targets (rice), and nutritional content [21]. Apart from that, the grouping of food commodities refers to research by [21] so that comparisons can be made to the results of this research. The following 12 food groups have been formed:

- Rice
- Non-rice (grains other than rice) and tubers
- Fresh fish
- Meat, eggs, and milk
- Vegetables
- Nuts
- Fruits
- Oil and coconut
- Drink ingredients
- Spices
- Other foods: other foods and preserved fish
- Food, beverages, and tobacco cigarettes

2.4. Analysis Method

Estimation of the demand function is carried out using the Linear Approximated – Almost Ideal Demand System (LA-AIDS) model. This model is a development of the Engel curve and the Marshallian equation which is derived from maximizing utility. The LA-AIDS equation in this study can be formulated as follows [9]:

$$w_i = \alpha_{0i} + \sum_{j=1}^{12} \gamma_{ij} lnp_j + \beta_i \, ln\_expfood\_defl + \alpha_{1i} ln\_nhm + \alpha_{2i} ln\_fac + \alpha_{3i} ln\_agehead + \alpha_{4i} schoolhead + \alpha_{5i} genderhead + \alpha_{6i} maritstatushead + \alpha_{7i} typearea + \alpha_{8i} poorstatus + \alpha_{9i} sourcehh + \alpha_{10i} healthhead + \alpha_{11i} internet + \alpha_{12i} asset + \alpha_{13i} businesshead + \alpha_{14i} accessfood + \alpha_{15i} aidfood + \alpha_{16i} IMR_i + \varepsilon_i \quad (1)$$

Information:

i, j	= 1, 2, ..., 12 (i/jth food group)
w_i	= proportion of expenditure on food group i
lnp_j	= natural logarithm of the estimated price of the jth food group
$ln\_expfood\_defl_h$	= natural logarithm of a household's total monthly food expenditure which has been deflated by the stone price index (P), namely$\ln P = \sum w_i \, lnp_i$
ln_nhm	= natural logarithm of the number of household members (people)
ln_fac	= natural logarithm of floor area per capita (m^2)
ln_agehead	= natural logarithm of the age of head of household (years)
schoolhead	= length of school of the age of head of household (years)
genderhead	= dummy head of household gender (1 = male, 0 = female)
maritstatushead	= dummy household head's marital status (1 = Married, 0 = Not married/divorced)
typearea	= dummy type of area where the household lives (1 = urban, 0 = rural)

poorstatus = dummy household poor status (1 = Poor, 0 = Not poor)
sourcehh = dummy largest source of household financing (1 = working household member, 0 = others)
healthhead = dummy physical health status of head of household (1 = Having difficulty taking care of themselves, 0 = Having no difficulty taking care of themselves)
internet = dummy household internet use (1 = Yes, 0 = No)
asset = dummy household asset ownership (1 = Has at least 1 asset, 0 = Has no assets)
businesshead = dummy head of household business field (1 = Agricultural sector, 0 = Non-agricultural sector)
accessfood = dummy difficulty accessing healthy and nutritious household food (1 = Yes, 0 = No/don't know/refuse to answer)
aidfood = dummy food aid for February 2021 and February 2022 (1 = Yes, 0 = No)
IMR_i = Inverse Mill's Ratio, correction variable for selectivity bias for the i[th] food group
$\alpha_0, \dots, \alpha_{16}, \gamma_{ij}$ = parameter
ε_i = error

The price variable for each food group is proxied by the amount of food expenditure divided by the total quantity also called the unit value of that food group. The following is the formula for calculating the unit value of the i-th food group (uv_i) [22] :

$$uv_i = \sum_{j=1}^{J_i} \left[uv_j \frac{e_j}{\sum_{j=1}^{J_i} e_j} \right] \quad (2)$$

with is the unit value of the j[th] commodity paid by the household which is formulated as follows :

$$uv_j = \frac{e_j}{q_j} \quad (3)$$

e_j is the expenditure value for the j[th] commodity and q_j is the amount of the j[th] commodity consumed by the household.

The use of this unit value can cause several problems [22]. First, it produces biased estimates because the unit value is influenced by the quality and quantity purchased. This problem can be overcome by using instrument variables. Second, there is a contemporaneous correlation problem or a correlation between errors in different equations. This can be overcome by using the Seemingly Unrelated Regression (SUR) estimation method. The final problem is selectivity bias. This bias arises because within a week there are households that do not consume certain food groups. If this value is ignored it will cause bias in the estimation results. The way to overcome this problem is to group all food commodities and add the Inverse Mill's Ratio (IMR) variable to the LA-AIDS model [22].

This model has several advantages compared to other demand functions, namely that it makes the estimation process easier because it involves many parameters without having to use non-linear methods. Apart from that, this model produces a good estimator because it is able to overcome basic assumption problems in Ordinary Least Squares (OLS) such as heteroscedasticity problems [11]. To overcome the problem of the basic assumptions of OLS, the LA-AIDS model is estimated using the SUR method with the Three-Stage Least Squares (3SLS) procedure. The next advantage is that there are several restrictions placed on the LA-AIDS model, resulting in estimates that are in accordance with demand theory. The following restrictions were applied in this study:

- Additivity : $\sum_{i=1}^{n} \alpha_i = 1; \sum_{i=1}^{n} \gamma_{ij} = 0; \sum_{i=1}^{n} \beta_i = 0$
- Homogeneity : $\sum_j \gamma_{ij} = 0$
- Slutsky Symmetry : $\gamma_{ij} = \gamma_{ji}$

The application of restrictions in this model also makes elasticity calculations simple and consistent with demand theory. The following is the formula for calculating demand elasticity [23]:

1. Own price elasticity (ε_{ii})

$$\varepsilon_{ii} = -(1 + \beta_i) + \frac{\gamma_{ii}}{w_i} \quad (4)$$

2. Cross price elasticity (ε_{ij})

$$\varepsilon_{ij} = \frac{\gamma_{ij}}{w_i} - \beta_i \left(\frac{w_j}{w_i}\right) \quad (5)$$

3. Income elasticity (η_i)

$$\eta_i = 1 + \frac{\beta_i}{w_i} \quad (6)$$

To get the elasticity of demand for food groups towards total household expenditure (food and non-food) this can be done by multiplying the equation by the elasticity of total food expenditure towards total household expenditure η_i [24]. The following is a linear equation to obtain the elasticity of total food expenditure on total household expenditure:

$$ln\, y_{food} = a + b\, lny_{expendituretotal} + \varepsilon \quad (7)$$

$$e_{tf} = \frac{\partial lny_{food}}{\partial lny_{expendituretotal}} = b \quad (8)$$

Information :

e_{tf} = elasticity of total food expenditure on total household expenditure
y_{food} = total monthly household food expenditure
$y_{expendituretotal}$ = total monthly household expenditure

Thus, we obtain the elasticity of demand for food groups towards total household expenditure (φ_i) which can be formulated as follows:

$$\varphi_i = \eta_i \,.\, e_{tf} \quad (9)$$

3. Results and Discussion

3.1. Analysis Overview of Household Food Consumption Patterns in Indonesia and the Factors that Influence Them in the Period March 2021 and March 2022

The amount of household food demand is related to price changes. When food prices increase, household demand tends to decrease. Conversely, if food prices decrease, the quantity demanded will increase.

Table 2. Average food prices (unit value) and changes according to food groups in Indonesia in the period March 2021 and March 2022 (Rupiah)

Food Group	Average Food Prices (Rupiah) (Unit Value)		
	March 2021	March 2022	% Change
(1)	(2)	(3)	(4)
Rice	10,359	10,791	4.165
Non rice and tubers	8,492	9,401	10.695
Fresh fish	29,029	30,874	6.356
Meat, eggs, and milk	27,200	28,496	4.763
Vegetables	19,264	16,343	-15.163
Nuts	11,687	12,598	7.794
Fruits	12,562	13,603	8.288
Oil and coconut	12,824	19,491	51.990
Drink ingredients	2,250	2,423	7.693
Spices	849	861	1.407
Other foods	3,993	4,272	6.972

Food Group	Average Food Prices (Rupiah) (Unit Value)		
	March 2021	March 2022	% Change
(1)	(2)	(3)	(4)
Food, beverages, and tobacco cigarettes	4,773	5,170	8.317

Source: Susenas Primary Data March 2021 and March 2022 (processed)

Table 2 is the result of price calculations for each food group using the approach unit value. In Table 2 column 4, it can be seen that the prices of almost all food groups have increased except for the vegetables group. In March 2022, several commodities in the vegetable group experienced price declines, such as cabbage, green beans, long beans, carrots, red chilies, and cayenne peppers [5]. Then, the oil and coconut group experienced the highest increase when compared to other food groups. This happened because, at the beginning of 2022, Indonesia experienced a shortage of cooking oil which caused the price of cooking oil to increase [25]. Apart from that, it can also be seen that strategic food commodity groups experienced price increases, such as rice; meat, eggs, and milk. Therefore, Table 2 proves that in March 2022, overall food prices will increase compared to March 2021.

Table 3. Average total monthly food expenditure, the proportion of household food expenditure, and changes according to food groups in Indonesia in the period March 2021 and March 2022

Food Group	Average total monthly food expenditure (Rupiah)			Proportion of food expenditure		
	March 2021	March 2022	% Change	March 2021	March 2022	% Change
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rice	265,118	267,540	0.914	0.119	0.113	-5.162
Non rice and tubers	60,069	63,566	5.822	0.027	0.027	-0.549
Fresh fish	187,795	203,292	8.252	0.084	0.086	1.735
Meat, eggs, and milk	227,001	239,458	5.488	0.102	0.101	-0.863
Vegetables	203,616	212,732	4.477	0.091	0.090	-1.813
Nuts	40,850	42,939	5.114	0.018	0.018	-1.214
Fruits	88,721	109,747	23.699	0.040	0.046	16.252
Oil and coconut	61,618	83,016	34.727	0.028	0.035	26.616
Drink ingredients	74,455	76,069	2.168	0.033	0.032	-3.983
Spices	49,382	54,630	10.627	0.022	0.023	3.967
Other foods	73,098	78,008	6.717	0.033	0.033	0.292
Food, beverages, and tobacco cigarettes	894,923	938,289	4.846	0.402	0.396	-1.466
Total	2,226,646	2,369,285	6.406	1.000	1.000	

Source: Susenas Primary Data March 2021 and March 2022 (processed)

Rising food prices will further influence household food consumption patterns. This can be seen in Table 3 which shows that the average total monthly food expenditure of households in Indonesia in March 2022 has increased compared to March 2021. The food group that has the highest average total monthly food expenditure is the food group, finished drinks, cigarettes, and tobacco. both in March 2021 and March 2022. Then followed by the rice group; meat, eggs, and milk groups. In column 4 it can be seen that in March 2022, the average total monthly household food expenditure for all food groups has increased compared to March 2021. However, column 7 shows that in March 2022 households decreased the proportion of their food expenditure compared to March 2021 for some food groups, namely the rice group; non rice and tubers; meat, eggs, and milk; vegetables; nuts; beverage ingredients; and food and drink become tobacco cigarettes. This shows that the increase in food prices makes households reduce the proportion of food expenditure for the six food groups and divert it to other food groups. The decrease in the proportion of food expenditure due to the increase in food prices shows that there has been a change in household food consumption patterns due to the increase in food prices in March 2022.

Apart from the price of goods, the diversity of household food expenditure is also influenced by several other factors. In this study, these factors are the socio-demographic characteristics of each household which can be seen in Table 4 as follows:

Table 4. Socio-demographic characteristics of households in Indonesia for the period March 2021 and March 2022

Sociodemographic Characteristics of Households	Mar-21	Mar-22
(1)	(2)	(3)
Average number of household members (people)	3.757	3.645
Average age of head of household (years)	48.157	48.744
Average length of school for head of household (years)	8.216	8.201
Average floor area per capita (m^2)	24.233	25.948
Area type: Urban (%)	42.090	41.848
Head of household gender: Male (%)	85.133	84.874
Household Marital Status: Married (%)	80.671	80.352
Physical health of head of household: having difficulty taking care of themselves (%)	3.635	1.596
Head of household business field: Agricultural sector (%)	41.435	41.682
Poor status: poor (%)	10.006	8.697
Main source of income: working household members (%)	91.992	92.356
Internet usage: Yes (%)	45.317	51.541
Asset ownership: own at least one asset (%)	95.377	95.927
Difficulty accessing healthy and nutritious food: Yes (%)	10.374	10.019
Receiving food aid: Yes (%)	15.887	14.394

Source: Susenas Primary Data March 2021 and March 2022 (processed)

Table 4 shows that all household characteristics in Indonesia in the two periods are almost the same except for several characteristics that have changed. In March 2022, households with the head of the household having difficulty taking care of themselves decreased by 2.04 percentage points when compared to March 2022. Likewise, poor households in March 2022 also experienced a decrease of 1.31 percentage points. Then, due to technological developments, internet use in households experienced a large increase, namely by 6.224 percentage points. Using the internet can make it easier for households to consume food by shopping online. Households receiving food assistance experienced a decrease of 1.493 percentage points. In conditions of increasing food prices, the government's role is needed to make it easier for households to meet their food needs. However, recipients of food aid actually experienced a decline.

3.2. Analysis of the Elasticity of Household Food Demand in Indonesia in the Period March 2021 and March 2022

The estimation results of the LA-AIDS model (equation 1) show that simultaneously obtained a p-value for all small food groups of 0.01, which means that overall the independent variables have a significant influence on the dependent variable with a significance level of 1%. The coefficient of determination (R-Square) value was obtained in the range of 6%-49% for March 2021 and 6%-44% for March 2022. This means that the variation in the proportion of food group expenditure that can be explained by the independent variable is 6% to 49% for March 2021 and 6% to 44% for March 2022, while the rest is influenced by factors outside the model. If a partial test is carried out, it is found that there are several variables that have no effect on the expenditure proportion variable for certain food groups.

The coefficient value of the LA-AIDS model cannot yet describe household sensitivity or household response to price changes. Therefore, to be able to see this, the LA-AIDS estimation results are used to calculate the elasticity value of food demand according to equations 4, 5, 6, and 9.

Consumer behavior is a theory that explains how consumers allocate their resources to consume various kinds of goods and services in order to maximize consumer satisfaction. Consumer decisions to make purchases are influenced by income and price [8]. The relationship between the quantity of goods

consumed at a certain price level and time can be shown from the demand function. The law of demand in economics explains that when the price of a good increases, consumers will reduce the quantity of that good. Consumer responses to price changes can be analyzed using the elasticity of demand value.

Demand elasticity is divided into uncompensated demand elasticity (Marshallian) and compensated demand elasticity (Hicksian). While elasticity is based on causal factors, elasticity is divided into three, namely:

a. Price elasticity

Price elasticity shows the percentage change in demand for goods due to a change in the price of the good itself by 1 percent [8]. The price elasticity value itself is usually negative. When the absolute value of elasticity is greater than 1, then the goods are goods that are elastic or responsive to changes in the price of the goods themselves. On the other hand, if the absolute value of price elasticity is less than 1, then it is an inelastic good. If the price elasticity value is equal to 1, then it is a unitary item, or the demand for the item is not influenced by changes in the price of the item itself.

b. Income elasticity

Income elasticity shows the percentage change in quantity demanded due to an increase in income of 1 percent [8]. If the income elasticity is greater than 1, then it is a luxury or superior product because it is more responsive to changes in income, for examples, luxury cars, jewelry, and so on. Meanwhile, if the income elasticity value is between 0 and 1, then it is a normal item which is a basic necessity item.

c. Cross price elasticity

Cross-price elasticity is the percentage change in demand for a good due to a 1 percent increase in the price of another good [20]. If the cross price elasticity value has a positive number then the relationship between the goods is substitution. If the cross-price elasticity value is negative, then the two goods are complementary.

Table 5. Own price elasticity and total household expenditure elasticity according to food groups for the period March 2021 and March 2022

Food Group	Own Price Elasticity		Elasticity of Total Expenditures	
	March 2021	March 2022	March 2021	March 2022
(1)	(2)	(3)	(4)	(5)
Rice	-0.430	-0.411	0.311	0.337
Non rice and tubers	-0.994	-1.140	0.525	0.596
Fresh fish	-0.780	-0.767	0.732	0.735
Meat, eggs, and milk	-0.695	-0.697	0.915	0.936
Vegetables	-0.774	-0.784	0.514	0.537
Nuts	-0.903	-0.904	0.476	0.530
Fruits	-0.648	-0.610	1.011	1.032
Oil and coconut	-1.036	-0.784	0.445	0.534
Drink ingredients	-0.801	-0.810	0.509	0.534
Spices	-0.852	-0.856	0.600	0.662
Other foods	-0.496	-0.512	0.833	0.853
Food, beverages, and tobacco cigarettes	-1.083	-1.073	1.180	1.148

Source: Susenas Primary Data March 2021 and March 2022 (processed)

Table 5 shows that the price elasticity value for all food groups has a negative number, which means that when the price of that food group increases, the quantity demanded of that food group will decrease, and vice versa. This shows that there is conformity with the demand theory.

In March 2021, all food groups had absolute price elasticity values smaller than 1 except for the oil and coconut groups; food, beverages, cigarettes, and tobacco. This means that the two groups are elastic with their price elasticity values of -1.036; and -1.083, which means that if the price of the two food groups increases by 10%, then the quantity demanded will decrease respectively by 10.360% and 10.830%. The results of this research are in line with research conducted by [21]. Meanwhile, food groups with an absolute value of their price elasticity that is smaller than 1, are inelastic goods, which

means that if there is a 10% increase in the price of a food group, then the quantity demanded of that group will decrease by less than 10%. In March 2022, the food groups that are elastic are the non-rice and tuber groups; food groups, ready-made drinks, cigarettes, and tobacco. The results of the study [21] also show that in March 2016 the food groups that were elastic were the non-rice and tuber groups; oil and coconut group; ready-made beverages, cigarettes, and tobacco food groups with price elasticity values each of -1.134; -1.148; and -1.064.

The rice price elasticity value of rice from the study [21] was -0.549. In [20], the price elasticity value for rice was also -0.411, which is almost the same as the results of this study. The inelastic rice price elasticity value indicates that households have low sensitivity to changes in rice prices. When the price of rice increases by 10%, the demand for rice will decrease by less than 10%. This is because the majority of households in Indonesia still have a high dependence on consuming rice as a source of carbohydrates. This means that rice has an important role in household consumption in Indonesia.

The total expenditure elasticity in Table 5 is an approximation of household income elasticity. The values of all total expenditure elasticity have positive numbers, which means that all food groups are included in normal goods. If total household expenditure increases, then the demand for that food group will also increase. In March 2021 and March 2022, the fruit group; The food, beverage, cigarette, and tobacco groups have a total expenditure elasticity value of more than one, which means that both groups include luxury goods or superior goods. The total expenditure elasticity value for the two groups is 1.011; 1.179 in March 2021 and 1.031; 1.148 in March 2022, which means that if total household expenditure increases by 10%, then the total demand for these two food groups will increase respectively by 10.110% and 11.790% in March 2021 and 10.310% and 11.480% in March 2022. In contrast to the results of [21], in March 2016 the food groups included in luxury goods were meat, eggs, milk; fruits; ready-made food and beverage groups, and cigarettes. Meanwhile, for food groups that have a total expenditure elasticity value of less than 1, it can be said that this food group is less responsive to changes in total household expenditure (income) or includes normal goods.

The rice group has the smallest food expenditure elasticity and total expenditure elasticity values compared to other food groups. Meanwhile, the food and beverages, cigarettes, and tobacco groups have the greatest value. This high sensitivity of households in consuming food, drink, cigarettes, and tobacco means that changes in household lifestyles occur when households become richer. The richer a household is, the more likely the household is to consume ready-made food, drinks, cigarettes, and tobacco which are more expensive [21].

Apart from the food drinks, cigarettes, and tobacco group, the fruit group is also a luxury good. Several fruit commodities experienced price increases during the COVID-19 pandemic. This is also proven by research [26] which found that there was an increase in the average price of fruit before and during the pandemic in traditional and modern markets with changes of 12.44% and 7.52% respectively in Jember City/Regency in 2021. High fruit prices can reduce the purchasing power of households, especially households with lower middle income. In fact, consuming fruit will help improve people's nutrition, thereby increasing a country's food security. Basic Health Research in 2018 stated that 95.5% of the Indonesian population consumed less than the recommended number of vegetables and fruit [27]. Therefore, the government's role is very important in monitoring food prices, especially strategic food groups which are basic needs and nutritional fulfillment for households in Indonesia.

Appendix 1 shows the cross-price elasticity for 12 food groups. A positive cross-price elasticity indicates that the two food groups have a substitution relationship. For example in March 2022, if the price of the rice group increases, then demand for the non-rice and tuber group and the beverage ingredients group will increase, while the other nine groups will experience a decrease in demand (complementary relationship). Then, symmetrically it can also be interpreted that in March 2022, if the prices of the non-rice and tuber groups and the beverage ingredients group increase, then demand for rice will increase, whereas if the prices of the other nine food groups increase, then demand for rice will decrease.

4. Conclusion

In March 2022, saw an increase in prices for strategic food commodities compared to March 2021. This resulted in a change in household food consumption patterns in Indonesia in March 2022, which was shown by a decrease in the proportion of food expenditure due to an increase in food prices. Apart from being influenced by food prices, the diversity of household food expenditure is also influenced by the socio-demographic characteristics of the household.

The own price elasticity value has a negative number which indicates that there is conformity with demand theory. Cross-price elasticities for some food groups have negative values (mutual

complementarity), while some have positive values (mutual substitutes). The elasticity of total household expenditure shows a positive value, which means that all food groups are included in normal goods. Fruit group; the food, ready-made drinks, cigarettes, and tobacco group are normal goods that are considered luxury goods in both March 2021 and March 2022.

The government is expected to be able to overcome and monitor rising food prices, especially for food groups which are important commodities for households in Indonesia. Suggestions for the next study could be to separate the ready-to-drink food group and the cigarette and tobacco group to find out how sensitive households are to price changes in these two food groups.

Ethics approval

This study was conducted in accordance with the ethical standards. Informed consent was obtained from all individual participants included in the study.

Acknowledgments

In this study, we would like to express our gratitude to Politeknik Statistika STIS for providing support and resources that have been provided. We also thank Badan Pusat Statistik (BPS) for providing data to support this study so that it can be useful for readers. The support and cooperation of all parties are very valuable for the success of this study.

Competing interests

All the authors declare that there are no conflicts of interest.

Funding

This study received no external funding.

Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

Credit Authorship

Wifa Darma Aulia: Conceptualization, Data Collection, Formal Analysis, Writing – Original Draft, Visualization. **Rita Yuliana**: Methodology, Writing – Review & Editing, Supervision.

References

[1]. Gloria, Pandemi Covid-19 Munculkan Kompleksitas Masalah Pangan [The COVID-19 Pandemic Creates Complexities in Food Issues], Mei 8. 2020, Berita Universitas Gadjah Mada: https://ugm.ac.id/id/berita/19397-pandemi-covid-19-munculkan-kompleksitas-masalah-pangan/. [Accessed Mei 14, 2024].

[2]. Firdaus. M, Disparitas Harga Pangan Strategis Sebelum dan Saat Pandemi COVID-19 [Price Disparity of Strategic Food Items Before and During the COVID-19 Pandemic], Jurnal Ekonomi Inodnesia. 107-120, 2021.

[3]. BPS, Indikator Ekonomi Maret 2022 [Economic Indicators March 2022], Jakarta: Badan Pusat Statistik, 2022a

[4]. BPS, Pengeluaran untuk Konsumsi Penduduk Indonesia [Consumption Expenditure of Population of Indonesia], Jakarta: Badan Pusat Statistik, 2017.

[5]. BPS, Statistik Harga Konsumen Pedesaan Kelompok Makanan 2022 [Rural Consumer Price Statistics Food Groups 2022], Jakarta: Badan Pusat Statistik, 2022b.
[6]. Andriessa. R, Pusat Studi Perdagangan Dunia, Universitas Gadjah Mada, Maret 5. 2022, Minyak goreng langka ? Ternyata inilah penyebabnya! [Is Cooking Oil Scarce? Here is the Cause!]: https://cwts.ugm.ac.id/2022/03/05/minyak-goreng-langka-ternyata-inilah-penyebabnya/. [Accessed June 6, 2023].
[7]. BPS, Statistik Harga Konsumen Pedesaan Kelompok Makanan 2021 [Rural Consumer Price Statistics Food Groups 2021], Jakarta: Badan Pusat Statistik, 2021
[8]. Pindyck. R. S, Rubinfeld, D. L, and Rabasco. E, Microeconomics (8th ed.), Jersey (USA): Pearson Education, 2013.
[9]. Deaton. A and Muellbauer. J, An Almost Ideal Demand System, The American Economic Review. 312-326, 1980.
[10]. Asikin. M, Risyanto, and Said. A, Manfaat Program Bantuan Langsung Tunai Terhadap Ketahanan Pangan Rumah Tangga Miskin : Studi Kasus di Kabupaten Karangasem dan Buleleng [The Benefits of Direct Cash Assistance Program for Household Food Security: A Case Study in Karangasem and Buleleng Districts, Bali Province], Jakarta: Direktorat Analisis dan Pengembangan Statistik Badan Pusat Statistik, 2009.
[11]. Farras. M. F, Anindita. R, and Asmara. R, Pola Konsumsi dan Permintaan Protein Hewani di Kota Malang Model Almost Ideal Demand System (AIDS) [Consumption Patterns and Demand for Animal Protein in Malang City Using the Almost Ideal Demand System (AIDS) Model], Jurnal Ekonomi Pertaniandan Agribisnis (JEPA). 286-297, 2021.
[12]. Heriyanto, Perilaku Konsumsi Pangan Sumber Karbohidrat Rumah Tangga Petani Kelapa Sawit di Kecamatan Kandis Kabupaten Siak [Consumption Behavior of Carbohydrate Food Sources in Oil Palm Farmers' Households in Kandis Subdistrict, Siak Regency], Jurnal Ilmiah Pertanian. 15-38, 2016.
[13]. Miranti. A, Syaukat. Y, and Harianto, Pola Konsumsi Pangan Rumah Tangga Di Provinsi Jawa Barat [Household Food Consumption Patterns in Jawa Barat Province], Jurnal Agro Ekonomi. 34, 67-80, Mei 26. 2016.
[14]. Nasution. A, Krisnamurthi. B, and Rachmina. D, Analisis Permintaan Pangan Rumah Tangga Penerima Manfaat Bantuan Pangan Non Tunai (BPNT) di Kota Bogor [Analysis of Food Demand Among Households Receiving Non-Cash Food Assistance (BNPT) in Municipality of Bogor], Forum Agribisnis, 1-10, 2020.
[15]. Novarista. N, Syahni. R, and Jafrinur, Faktor-Faktor yang Mempengaruhi Konsumsi Pangan Hewani Pada Konsumen Rumahtangga di Kota Padang [Factors Affecting Animal-Based Food Consumption Among Household Consumers in Manucipality of Padang], Jurnal Agribisnis Kerakyatan. 64-74, 2013.
[16]. Nursamsi, Nurmalina. R, and Rifin. A, Kajian Sistem Permintaan Komoditas Sumber Protein di Enam Propinsi di Indoneisa [Study of Demand Systems for Protein Source Commodities in Six Province of Indonesia], Jurnal Agribisnis Indonesia. 142-156, 2019.
[17]. Ritonga. H, The impact of household characteristics on household consumption behavior : A demand system analysis on the consumption behavior of urban households in the province of Central Java. Indonesia, IOWA STATE UNIVERSITY, 1994.
[18]. Sari. N. A, Analisis Pola Konsumsi Pangan Daerah Perkotaan dan Pedesaan Serta Keterkaitannya Dengan Karakteristik Sosial Ekonomi di Provinsi Kalimantan Timur [Analysis of Food Consumption Patterns in Urban and Rural Areas and Their Relationship with Socio-Economic Characteristics in Kalimantan Timur Province], JEMI. 69-81, 2016.
[19]. Suryanty. M and Reswita. R, Analisis Konsumsi Pangan Berbasis Protein Hewani di Kabupaten Lebong : Pendekatan Model AIDS (Almost Ideal Demand System) [Animal Protein Based Food Consumption Analysis in District of Lebong: AIDS Approach], AGRISEP. 101-109, 2016.
[20]. Wijayanti. P. D, Harianto, and Suryana. A, Permintaan Pangan Sumber Karbohidrat di Indonesia [Carbohydrate Food Demand in Indonesia], Analisis Kebijakan Pertanian. 13-26, 2019.
[21]. Yuliana. R, Permintaan Pangan dan Perubahan Tingkat Kesejahteraan Rumah Tangga di Indonesia [Food Demand and Changes in Household Welfare Levels in Indonesia], Bogor: Institut Pertanian Bogor (IPB), 2018.
[22]. Moeis. Jossy P, Indonesian Food Demand System: An Analysis of the Impact of the Economic Crisis On Household Consumption and Nutritional Intake, Washington DC (US): The George Washington Univ, 2003.
[23]. Ackah. C and Appleton. S, Food price changes and consumer welfare in Ghana in the 1990s, University of Nottingham: CREDIT Research Paper No 07/03, 2007.

[24]. Teklu. T and Johnson. S. R, Demand Systems from Cross Section Data: An Experiment for Indonesia, CARD Working Papers, 1987.
[25]. Yafiz. I and Pahlevi. A, "Minyak goreng melimpah setelah harga eceran tertinggi dicabut, tapi sekarang harganya mahal" ["Cooking Oil Abundance After the Removal of the Highest Retail Price Cap, But Now the Price is High"], Maret 19. 2022, BBC News Indonesia: https://www.bbc.com/indonesia/indonesia-60754619. [Accessed Mei 16, 2024].
[26]. Ferdiansyah. Nur Muhammad, Fauzi. Nurul Fathiyah, and Prayuginingsih. H, Permintaan dan Penawaran Buah di Wilayah Kota Kabupaten Jember Pada Masa Pandemi Covid-19 [Demand and Supply of Fruits in the Jember Regency Area During the COVID-19 Pandemic], National Multidisciplinary Sciences. 262-267, 2022.
[27]. Kementerian Kesehatan, Hasil Utama RISKESDAS 2018 [Key Findings of RISKEDAS 2018], Jakarta, 2018.

Appendix 1. Marshallian price elasticity of 12 food groups for the period March 2021 and March 2022

Food Group	Rice	Non rice and tubers	Fresh fish	Meat, eggs, and milk	Vegetables	Nuts	Fruits	Oil and coconut	Drink ingredients	Spices	Other foods	Food, beverages, and tobacco cigarettes
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
March-2021												
Rice	**-0.4303**	0.0224	-0.1440	-0.0321	-0.0476	-0.0214	-0.0487	0.0134	0.0249	-0.0085	-0.0183	-0.0419
Non rice and tubers	0.0816	**-0.9939**	0.5263	0.0626	-0.2300	0.0833	-0.0692	0.0885	0.0179	0.0038	-0.0977	-0.1197
Fresh fish	-0.2712	0.1628	**-0.7803**	-0.0517	-0.0024	0.0406	0.0116	0.0053	-0.0271	-0.0011	-0.0256	0.0392
Meat, eggs, and milk	-0.0836	-0.0004	-0.0645	**-0.6953**	-0.0359	-0.0190	-0.0068	-0.0256	-0.0234	-0.0184	-0.0302	-0.1341
Vegetables	-0.0561	-0.0347	0.0244	0.0121	**-0.7735**	0.0145	-0.0053	0.0286	0.0075	0.0099	0.0242	-0.0237
Nuts	-0.2136	0.1104	0.1643	0.0107	0.0740	**-0.9027**	-0.0226	0.0094	0.0925	0.0670	-0.0804	0.0039
Friuts	-0.2438	-0.0732	-0.0006	0.0077	-0.0389	-0.0259	**-0.6484**	-0.0360	-0.0237	0.0081	-0.0576	0.0560
Oil and coconut	0.0039	0.0671	0.0063	-0.0225	0.0836	0.0131	-0.0172	**-1.0361**	0.0375	0.0174	0.0691	-0.0171
Drink ingredients	0.0434	0.0038	-0.0679	-0.0116	0.0114	0.0540	-0.0045	0.0289	**-0.8006**	0.0181	-0.0409	-0.0931
Spices	-0.1355	-0.0182	-0.0265	-0.0143	0.0191	0.0542	0.0350	0.0103	0.0438	**-0.8521**	0.0215	-0.0221
Other foods	-0.1408	-0.0975	-0.0839	-0.0489	0.0468	-0.0582	-0.0557	0.0466	-0.0684	0.0215	**-0.4960**	-0.0786
Food, beverages, and tobacco cigarettes	-0.0376	-0.0261	-0.0089	-0.0459	-0.0239	-0.0161	-0.0089	-0.0184	-0.0259	-0.0175	-0.0221	**-1.0834**
March-2022												
Rice	**-0.4108**	0.0338	-0.1460	-0.0337	-0.0451	-0.0017	-0.0464	-0.0385	0.0229	-0.0087	-0.0274	-0.0533
Non rice and tubers	0.1344	**-1.1402**	0.5491	0.0557	-0.2378	0.0937	-0.1342	0.0597	0.0549	0.0000	-0.0787	-0.0785
Fresh fish	-0.2519	0.1621	**-0.7672**	-0.0599	0.0598	0.0312	-0.0254	-0.0054	-0.0323	-0.0019	-0.0421	0.0383
Meat, eggs, and milk	-0.0819	-0.0024	-0.0754	**-0.6973**	-0.0347	-0.0193	-0.0130	-0.0304	-0.0237	-0.0191	-0.0260	-0.1280
Vegetables	-0.0501	-0.0362	0.0752	0.0118	**-0.7845**	-0.0201	-0.0226	0.0319	0.0026	0.0070	0.0253	-0.0273

Food Group	Rice	Non rice and tubers	Fresh fish	Meat, eggs, and milk	Vegetables	Nuts	Fruits	Oil and coconut	Drink ingredients	Spices	Other foods	Food, beverages, and tobacco cigarettes
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Nuts	-0.0748	0.1228	0.1221	0.007	-0.0950	**-0.9038**	0.0193	-0.0318	0.0907	0.0667	-0.0567	0.0114
Friuts	-0.1886	-0.0953	-0.0721	-0.0049	-0.0701	-0.0036	**-0.6099**	-0.0456	-0.0176	-0.0012	-0.0653	0.0831
Oil and coconut	-0.1654	0.0393	-0.0174	-0.0246	0.0770	-0.0090	-0.0248	**-0.7845**	0.0067	0.0107	0.0846	-0.0174
Drink ingredients	0.0427	0.0362	-0.0848	-0.0131	0.0016	0.0561	0.0044	0.0074	**-0.8096**	0.0211	-0.0458	-0.0659
Spices	-0.1209	-0.0169	-0.0335	-0.0151	0.0064	0.0489	0.0227	0.0038	0.0350	**-0.8561**	0.0203	-0.0117
Other foods	-0.1625	-0.0753	-0.1262	-0.0347	0.0498	-0.0432	-0.0714	0.0799	-0.0642	0.0157	**-0.5120**	-0.0776
Food, beverages, and tobacco cigarettes	-0.0385	-0.0208	-0.0072	-0.0425	-0.0229	-0.0140	-0.0024	-0.0169	-0.0210	-0.0150	-0.0199	**-1.0730**